and the captain of a steamer which reached that port September 21 reported a fresh southwest wind and a steady barometer during the hours at which the *Parnass*, not more than 50 miles distant, was battling with the full force of the hurricane.

Trustworthy reports of these storms are rare, and for this reason it is impossible to draw definite conclusions as to the direction and velocity of motion of the storm center. No reports of their occurrence south of the fifteenth parallel have thus far been received, although Captain Sewall, of the American ship *Paul Revere*, described an encounter with a storm of a similar nature, August 8, 1888, in N. 15°, W. 116°, the storm beginning on the evening of August 7, with the wind from the southeast and a heavy swell from southwest. In the vicinity of the mouth of the Gulf of California the path of the storm is, in general, northerly, following the line of the coast at some distance to seaward.

SUNSHINE.

The occurrence of 100 per cent in the column of duration of sunshine during the first morning hour often strikes the eye by contrast with the rare occurrence of the same high percentage at other hours of the day. This was especially the case in Table IV for October, 1895. As a rule, neither haze, fog, pallium, nor cirrus prevails in the dry American climates, but the principal cloud is the cumulus of midday. The early mornings at or before sunrise are cloudless, but as soon as the surface ground is heated by the sun and the topsy-turvy movements of the daytime begin there begins a steadily increasing amount of cloudiness. It may thus happen, for instance, that if the total duration of sunshine before 6 a. m. is only a few minutes at any station, all of it will be clear sky, whereas if the sunshine had lasted for nearly the whole hour, as it does between six and seven, then the percentage would have dropped lower.

DROUGHT AND AGRICULTURE.

The recent long-continued drought has stimulated the consideration of the question whether there is any permanent change in the quantity of water held in the lakes, both large and small, that cover our so-called Lake Region. It is stated with some show of credibility that during the past ten years there has been a very appreciable drying up of the smaller lakes in Minnesota, and that cultivated fields now occupy the rich lake bottoms that were formerly covered with from 10 to 20 feet of water. The St. Paul Pioneer Press publishes letters from a large number of correspondents representing the whole area of the State, showing that the larger lakes have diminished in volume and the smaller ones have often dried up entirely. A similar story comes from South Dakota. The average rainfall of the past ten years may have been slightly below the normal in these States, but not to a sufficient extent to justify us in attributing this change in the lakes to any great meteorological or climatological change. The fundamental reason for the drying up of the lakes is to be found in the cultivation of the soil and the artificial changes in the drainage. Every acre of virgin soil that is plowed up and cultivated begins to evaporate into the air the moisture that it formerly conserved. Similarly every new drain that is dug helps the water that formerly stayed in the soil to flow off into the rivers. The progress of agriculture begins by an effort to drain the rich lowlands that are usually too wet and ends by the necessity of artificially watering both the dry uplands as well as the warm lowlands. In other words, we begin by evaporating and draining off the water that we eventually wish we could get back again. Successful agriculture involves a steady progress toward the need of more water and the wisest way of using it, but the atmosphere presents an irregular succession of dry years and wet years, and agricultural methods must vary to suit the seasons. In the words of the Pioneer Press:

> Of the seven thousand lakes that dotted Minnesota in 1885 perhaps a third of them will permanently disappear as a result of the cultivation of the soil, the remainder will fluctuate in volume with the average rainfall, shrinking materially during successive dry seasons and reappearing in all their ancient beauty when the rain comes back to fill their empty bowls.

The above considerations emphasize what we have often said about the importance of long-range predictions as to the character of the coming seasons. The same idea is emphasized in the following quotation from the Sioux City Journal:

> What really is needed is a better understanding of the conditions that bring about our seasons—our periods of prolonged drought and our periods of continuous wet weather. We want meteorology made plainer, to the end that farmers may be better prepared for meeting unfavorable conditions. We want a better understanding of causes and effects, and then a better understanding of the way to take care of all the moisture we have or to get rid of what moisture we do not want. It has been demonstrated that a dry season is good for crops, for the season just closed was a good crop season. The science of agriculture is one that will repay careful study. It is worthy of the best thought of the day, and meteorology ought to supplement agriculture to the great benefit of the latter.

CHINOOK IN MONTANA.

According to R. M. Crawford in the Monthly meteorological summary of the Montana Weather Service the Observer, C. L. Herzog, at Great Falls in that State (N. 47° 28′, W. 111° 20′) states that—

> A peculiar phenomenon was closely observed there on the 16th inst. A cold-wave signal having been ordered for that date, the weather at time of receipt of order was very warm and pleasant, and the observer decided to pay more than ordinary attention to the expected change. About 3.30 p. m. the wind which had been blowing gently from the north, veering at times to the northeast, with a velocity of about 9 miles an hour, stiffened quickly and coming directly from the north lowered the temperature 6° in less than five minutes. The indications were that the temperature would fall much lower, but suddenly dark vaporous looking clouds appeared in the extreme southwest, with them simultaneously came a strong gale from the same quarter, blowing at the rate of at least 40 miles an hour. The southwest gale seemed to meet the wind coming in from the north and drove it in a whirl directly toward the northeast across the prairie in a funnel-shaped cone, plainly perceptible for a long distance by the dust gathered. The temperature quickly rose to 58°, the maximum recorded for this date, and the chinook had mastered the cold wave.

[NOTE.—Great Falls is on the Missouri River about 30 miles above Fort Benton, and 60 miles in a straight line, or 150 miles by the river, northeast of Helena. To the north and west are the elevated prairie lands, famous grazing pasture and the last retreat of the almost extinct bison. To the south and west the hills rapidly increase and become the Rocky Mountains. The contour line of 5,000 feet elevation lies about 20 miles to the south, but about 60 miles to the west. Great Falls itself is on the 3,000 foot contour line which crosses the Missouri at this place and extends down the river valley, and but a short distance from it, for 200 miles. On the 15th and 16th an area of high pressure, 30.6, covered Oregon and northern California and extended southeastward into Utah, while low pressure prevailed in Alberta. The cold north and northwest winds on the southwest side of the low were probably felt not only in Alberta but southward and up to an altitude of 3,000 feet. But any air that was pushed into the low pressure from the high area in Oregon and Idaho must necessarily descend through the lowest gap in the Rocky Mountains, which is about 50 miles southwest of Great Falls, and therefore from an altitude of at least 6,000 feet. Through this, and similar gaps farther northwest which are not so low, a descending current always flows over western Montana when the general distribution of pressure is as above described, and warm chinooks extend down to some level such as that of 3,000 feet. There the mixture with the cold northerly winds from Alberta and Saskatchewan begins, and sometimes for several days the border line between warm and cold sways to and fro. Observers in this region have an opportunity to observe several interesting phenomena such as the mixture of the two winds and the character of the clouds formed thereby, or the remarkable connection between temperature and pressure. At one time rising pressure means warmer weather, at other times colder weather. If each observer will record the time at which the winds and clouds change direction, and will also record either the temperatures or the fact of changes from cold to warm, he will enable the student of this matter to draw systems of lines showing the front of the chinook and the opposing front of the cold wave at any time. It is believed that between these two fronts there is an intermediate belt of neutral ground that may be 5 or 50 miles wide, the location of which is important in regulating the display of cold wave signals. The chinook appears sometimes to pass overhead over a broad strip of country and descend some distance beyond, but is eventually pushed back to the mountains. Thus in November, 1894, the chinook began at Havre (Fort Assiniboine), 60 miles northeast of Fort Benton, on the 13th at 11 p. m., but at Helena, southwest of Fort Benton, on the 14th, at 9 a. m. In this case the whole northwestern corner of Montana was first filled by the warm southwest chinook, which was then pushed southward by underflowing cold northwest winds from Alberta.

The study of the exact extent and progress of the chinook is hindered by the fact that many of our voluntary observers fail to make a complete record of the phenomena that they observe, so that only fragments of knowledge come to our hands, while the observer knows by experience many important local details. The whole subject can best be studied by plotting upon a series of contour maps the detailed records that we hope to receive from our observers in that section.]

CONTRIBUTIONS TO THE WEATHER REVIEW.

In order that all the observers and officials of the Weather Bureau may profit by the numerous interesting observations that are frequently made in distant parts of the country, the Chief of the Bureau has authorized the issue of a circular letter, No. 17, of 1895, from which the following extract is made:

By direction of the Chief of Bureau, I am requested to say that any short article that you may desire to offer for publication in the MONTHLY WEATHER REVIEW will be taken into favorable consideration. Papers that are too technical for publication in the daily newspapers or popular journals, or in the monthly bulletins of the State Weather Services, or those that relate to matters of general rather than local interest, are appropriate to the MONTHLY WEATHER REVIEW.

If the article should not be accepted for the REVIEW, it will be returned to you, with such suggestions, relative to its publication, as may seem proper to the Chief.

METEOROLOGICAL TABLES.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only the 8 p. m. observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation.

Table II gives, for about 2,400 stations occupied by voluntary observers, the extreme maximum and minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (....).

Table III gives, for about 30 Canadian stations, the mean pressure, mean temperature, total precipitation, prevailing wind, and the respective departures from normal values. Reports from Newfoundland and Bermuda are included in this table for convenience of tabulation.

Table IV gives, for 29 stations, the mean hourly temperatures deduced from thermographs of the pattern described and figured in the Report of the Chief of the Weather Bureau, 1891–'92, p. 29.

Table V gives, for 28 stations, the mean hourly pressures as automatically registered by Richard barographs, except for Washington, D. C., where Foreman's barograph is in use. Both instruments are described in the Report of the Chief of the Weather Bureau, 1891–'92, pp. 26 and 30.

Table VI gives, for 136 stations, the arithmetical means of the hourly movements of the wind ending with the respective hours, as registered automatically by the Robinson anemometer, in conjunction with an electrical recording mechanism, described and illustrated in the Report of the Chief of the Weather Bureau, 1891–'92, p. 19.

Table VII gives the danger points, the highest, lowest, and mean stages of water in the rivers at cities and towns on the principal rivers; also the distance of the station from the river mouth along the river channel.

Table VIII gives the maximum, minimum, and mean readings of the wet-bulb thermometer for 135 stations, as determined by observations of the whirled psychrometer at 8 a. m. and 8 p. m., daily.

The difference between mean local time and seventy-fifth meridian time is also given in the table.

Table IX gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division one may obtain the average resultant direction for that division.

Table X gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table XI gives, for 38 stations, the percentages of hourly sunshine as derived from the automatic records made by two essentially different types of instruments, designated, respectively, the thermometric recorder and the photographic recorder. The kind of instrument used at each station is indicated in the table by the letter T or P in the column following the name of the station.

Table XII gives the records of hourly precipitation as reported by stations equipped with automatic gauges, of which 37 are known as float gauges and 7 as weighing rain and snow gauges.

Table XIII gives the record of excessive precipitation at all stations from which reports are received.

Table XIV gives a record of the heaviest rainfalls for periods of five and ten minutes and one hour, as reported by regular stations of the Weather Bureau furnished with self-registering rain gauges.

Additional information concerning the tables will be found in the January, 1895, REVIEW.